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OF THE
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ON ITS
CAUSES AND CONSEQUENCES.

TOGETHER WITH
A PLAN FOR PAVING
UPON A NEW PRINCIPLE.

BY WILLIAM DEYKES, GENT.

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THE bad state of the pavement of the streets of London has for many years attracted my notice, and more particularly when driving or riding.

I have been an attentive observer of paviours; and though convinced thier operations might have been much better performed, I did not perceive by what means (depending upon their care and attention) the system could be materially improved. The subject has continually forced itself upon my mind; and, without knowing wherefore, I have felt a peculiar interest in it. Under such circumstances, the amazing accumulations of mud and dirt which, though often swept up and removed, were still succeeded again and again by equally large quantities, could not fail to excite notice, and the reflection was induced, Where could it possibly come from?

The result of my observations and reflections has been, 1st, The formation of ideas relative to the first principles governing the construction and stability of pavements; and 2ndly, The means by which those first principles may be best rendered available. My conclusions on both heads will be found in the following pages; but I must solicit indulgence for imperfections of style, and deficiencies in geometrical and mathematical elucidations. As all men are fully warranted in seeking to make the results of their studies and labours available to their profit, I readily admit that I reflected with solicitude upon the most probable means by which that end could be attained. The idea which first suggested itself was of a Joint-stock chartered Company to pave all the streets of London at its cost upon the new principle, and keep them in repair upon engagements to be entered into for 10 or 20 years, and receive rents from the Commissioners of Districts upon certain averages of previous expenditure. But I her in approximating towards that perfect system to which the wisdom of succeeding generations will one day attain, and England lead the way.

London, the renowned city of the world and centre of commerce, has largely benefited by the enlightened course she has pursued. Her institutions and establishments (too numerous and too eminently celebrated to allow of more than general expression of admiration) are alike the wonder of the Old World, and the objects of emulation to the New.

Her Water Companies—Bridges—Gas Light illuminations, and Steam Boat navigation, tending to the convenience and enjoyment of life;—her Assurances for Lives,—Fire,—and the perils of the Sea, contributing to the amelioration of the evils of life, all equally result from the enterprising spirit of her inhabitants; and it may be asserted without fear of contradiction, that there is no enterprise too daring, or project too intricate, that their genius and industry, aided by their unlimited funds, cannot accomplish.

Amongst other objects of high importance, the improvement of the streets of London has been a prominent consideration; the progressive changes have been marked, and are too generally known to need more than cursory notice. Not more than two or three centuries ago, but few of the streets were paved at all; and the various histories of London record the arduous journey from Temple Bar to Charing Cross, and the impassable state of Holborn, arising from the defect. At a less remote period, the flag-stone pavement for foot passengers was introduced (how much to general comfort and convenience every person is competent to judge).

More recently the adoption of squared paving stones instead of the small round ones called pitchen stones, together with the improved mode of paving in parallel lines from curb to curb, has materially improved the streets of London.

Still however, with every improvement hitherto suggested, the pavement of the streets has always been and to the present day remains most inconveniently defective, though very great annual expenditure has taken place; nor has any invention hitherto been announced to remedy the acknowledged defect. The names of Telford and M^cAdam stand justly pre-eminent in the science of Road-making, and it is not for me, nor do I intend, to dispute their claim to high consideration and estimation; so far the reverse, that I am free to confess I do not conceive the theories and practice introduced by those gentlemen respectively can be improved upon. But this admission I must confine to apply to roads only. The application to streets of the principle introduced by Mr. M^cAdam is now only in course of trial; and I refrain from expressing any opinion on its efficacy or fallacy. The experience of the public will best determine. But as Mr. M^cAdam himself admits (if I do not greatly mistake) that his theory cannot with advantage be practised upon those narrow and confined streets which are great thoroughfares; and as many of the warmest advocates of the theory, and friends to the practice of *Macadamization* admit, whilst they regret, the increased creation and accumulation of dust and sand, in drawback of the merits of the device; it hence appears that as applicable to streets the point of perfection is not yet attained.

Leaving Mr. M^cAdam's system in full possession of the roads, and to its action upon the streets of London according as experience shall teach the public to adopt or reject it, I shall state under distinct heads the various faults, defects, and inconveniencies of the pavement of the metropolis, always meaning in the general term "pavement," the carriage-way only of the streets.

1st. The pavement is so continually out of repair that it baffles the most vigilant superintendence to keep even the greatest thoroughfares in a tolerably good state: in instance of this, the new and most expensive pavement (equal to any in London) with which the whole of the Strand has recently been repaved, already evidences impairment fully characteristic of the causes to which the general imperfections of pavements are herein attributed.

2ndly, The dust in dry weather is greatly annoying, and highly injurious to goods and furniture, to say nothing of personal feeling and annoyance in having the eyes blinded and the mouth choked therewith. And no sooner is there a wet day, than the streets become ponds of mud. By the time the accumulation is almost intolerable the scavenger commences the annoyance of sweeping, and scooping it into his carts, and splashing and bespattering every passer by not prudent enough to cross out of his way; and be content to be covered over the ancles with mud, rather than over neck and ears. To this item may also be charged the never-ending scourings, brushings, and cleansings of carriages, by which the superb and highly painted and polished pannels are scratched and defaced, and their lustre obscured. As to ladies' and gentlemen's dresses, I leave individual feeling to its own operation.

3rdly, The unevenness to which the surface is liable, and which gives rise to many accidents by passengers and horses falling. From the same cause carriages and vehicles of every description become shaken and old and deteriorated many years earlier than upon passage over a surface more evenly preserved they would do; whilst the jolting motion (which the most improved springs cannot obviate) and deafening noise being also attributable to this cause, further increase the items of the account chargeable to this head of defect and consequent inconvenience.

4thly, The wide-gaping intersections or interstices between the paving stones. To those who have neither sprained an ancle nor filled a shoe with mud, this item will not be intelligible; but to those who have I need say no more. By the admirer of the grandest quadruped in nature—the horse—the subject will be appreciated and felt with a compassionate interest inherent in every generous breast, when convinced (as every person must be at all qualified to form an opinion) that to this cause in a very great degree may be attributed the various injuries to the sinews and tendons of the legs, the fruitful source of all the founderings, firings, and blisterings, which that noble animal in its brief existence endures.

Such being the most palpable defects and imperfections of the pavement, and such the injurious, prejudicial and inconvenient consequences, I shall proceed to show the causes from which they result; and afterwards (as explanatory of my invention) describe the means by which I propose a remedy.

The several points of consideration, though stated under separate heads, are intimately connected in cause and effect, and may therefore be treated of collectively.

The necessity of frequent repair arises almost wholly from the aptitude of the earth, on becoming saturated with wet, to lose its natural consistency and become mud; and consequently that foundation for pavement which ought to be hard and inductile, becomes soft and penetrable. The multitudinous and unceasing passage of immense weights over the surface keeps the stones in constant sway and motion, and propels them downwards into the softened foundation. The surface of the pavement being thus once disorganized, and even a single stone forced below the general surface, each succeeding wheel in its revolving motion jolts into the hole thence formed, and acting with an impelling power from time to time deepens and enlarges it; the effect of which is, that the stones in immediate contact, losing on one side that equal support which previously existed, incline to the defective part, and the defective parts existing in many places, hence the ruin spreads and the streets become such as every day's experience presents to our view.

The second head of objection results from the same cause as the preceding. The gravel in the interstices between the stones becoming wet, loses its proper consistency. By the operation of gravitation and law of motion, as the heavier body sinks or is impelled downwards the lighter body of fluid is thrown upwards and ejected. Thus the gravel between and the earth under the stones are forced upwards in quantity in proportion to the sinking of the stones, and form on the surface of the pavement mud more or less diluted according to the quantity of rain which it has imbibed. The gravel in a wet state exudes also by the lateral pressure of one stone against another. To make myself better understood on this point, I may be allowed to amplify. As Fleet-street extends east and west, suppose a team and waggon proceeding westward,—the purchase for the feet of the horses will be on that edge of each stone which is towards the west, and the pressure consequently against the stone immediately eastward of that acted upon; the effect will be, that the wet gravel will be pressed upwards from between those stones acted upon, and an interstice or gap formed on the opposite side, which becomes the nuisance noticed under the 4th head of objection. The horses and waggon returning eastward, the same action takes place but in an opposite direction; and thus each particular stone, instead of being fixed firm and immovable, becomes a rocking stone, and by consequence all its angles are destroyed, the edges become rounded, and the stones unfit for further use but in secondary or minor streets. As this climate is particularly subject to rain, the evils pointed out are constantly in progress, and cannot under the present imperfect system be checked, although many thousands of pounds are annually expended in the endeavour. As the correctness of the foregoing explanation may by some persons be doubted, I request the public individually to consider—from what source the (otherwise amazing) quantity of mud which is washed by rain into the sewers, and carted away by the scavengers, arises. Where does it come from? How is it else produced? Are cause and effect confounded, and mistaken the one for the other? Is the mud or the dust the primary nuisance? in other words, does the dust (in the first instance) result from the mud, or the mud from the dust? The former must certainly be the real state of the case.

To be convinced of it, let any person reflect how nicely imbosomed, roundly elevated and plump, a new pavement for a short time appears after many loads of gravel have replaced past expenditure; let him consider what renders fresh gravel always necessary upon relaying pavements, by which will be induced the further consideration in immediate connection with it, of what becomes of the vast quantities which from time to time are expended?

The foregoing observations embrace also the considerations connected with the third and fourth heads of objection. The unevenness of the surface of the pavement, and the dangerous openings between the stones, alike result from the causes pointed out; all the defects are consequent upon each other; and when once dilapidation commences, speedy impairment and disorganization follow, and are shortly succeeded by total and irretrievable destruction.

I have refrained from imputing any of the defects in the existing system to the paviours, though an observation or two might be made in that point of view of the subject: but it is nevertheless my confident opinion that no care on their parts could render materially better a system, the results of which have hitherto proved so bad:—there exists a radical defect.

It remains for me to propose the principle, and to explain the detail of a plan which, from frequent consideration of the subject, I have conceived to remedy and obviate all the several objections pointed out; and indeed it would be but a sorry employ to insist upon objections, and assail a system as defective, if not prepared to obviate the former by the substitution of another system which, if not absolutely perfect, will nevertheless prove at least greatly superior to the one condemned.

Considering as an absolutely requisite principle for the construction of a good pavement, that the stones should be firmly fixed and immoveable, I adopt that one principle, and shall endeavour to prove in the sequel that every objection treated of may be obviated by the means pointed out for effecting so great and desirable an object of public importance. Each stone, from a foreign or external force acting upon the surface of a pavement, is liable to two motions only, the gravitating, and the lateral; these being guarded against, the end is attained.

The means of effecting this object, though simple, are expensive: but with Englishmen this is not an insuperable objection. Moreover I have a confident expectation, amounting almost to a moral assurance, that although the first expenditure will be very heavy, yet the durable and lasting qualities of a pavement so constructed will very shortly prove it to be the most expedient and economical plan, particularly as applicable to the leading thoroughfares. I proceed to a development.

The ground being sunk 15 or 16 inches below the foot-path or flag-pavement, should be levelled and rolled hard, rising towards the middle of the street in a very small degree. Upon this ground thus prepared should then be laid planks two inches thick, well saturated (in order to their preservation) by previous soaking in coal tar, which is a very cheap commodity; a few auger holes of about an inch diameter should be bored in them. These being laid side by side upon the ground, either in the direction in which the street extends, or across it, (as may be considered most convenient in reference to the operations of the Commissioners of Sewers, and the Water and Gas Light Companies,) will form a compact flooring, upon which clean finely sifted gravel must be strewed two inches thick (to obviate inequalities and unevenness in the stones, and to prevent their indenting, crushing, or perforating the planks); the stones should then be placed side by side upon the gravel, according to the present method, taking care that the lines of division intersect each other, and that the stones are of an equal depth. Gravel should afterwards be strewed over the surface lightly, in order to fill in between the stones. Any given space being thus laid and bounded, so as not to admit of any lateral movement or change of position of the stones, wooden wedges should be inserted into the interstices and lightly struck down, but only in a small degree until the whole are inserted; after which in regular progression all the wedges should be struck in about half way, which may be done without much labour; and when all are so done, then finally again, in regular progression, they should be struck in the whole way, with whatever force may be requisite, level and even with the stones, which thus conjoined, will form a pavement of a pleasing, even surface, of a firm, immoveable, and almost impenetrable nature, superior to any ever yet formed.

A pavement thus constructed would not for a series of years become dilapidated, and, as before observed, although expensive in the first instance would amply repay a large expenditure by the saving of succeeding years. The planking would last 20, 30, or many more years, according to the quality or properties of the timber, upon the nature of which I am incompetent to offer an opinion; but a proper kind may be chosen, and also for the wedges, many thousands of which may be daily made by a few men. Two sizes only will be required, one for the ends of the stones, and another for the sides; the depth will be uniform according to the depth of the stones.

Many considerations might be here entered upon in anticipation of objections which may be suggested against the plan, but which being the never-failing attendant of novel schemes, I shall not meet by anticipation; and I have much confidence that the plan (perfectly novel in itself, and abounding in interesting results,) will merit public attention and universal adoption.

I proceed to show the effects which I consider will result from this mode of paving, now first published to the world. The earth being covered by planks, and therefore not subject to any diluent action, will maintain its natural consistency, and cannot waste by being forced upwards to the surface in the manner I have endeavoured to explain such process takes place under the present imperfect system. The two-fold effect of this will be, that the pavement will not lose its foundation by the sinking of the earth, and therefore it will maintain its surface; and also (as truly as the effect follows the cause) the streets will be perfectly free from mud and dirt!!!

Having shown that the planking will prevent the gravitating motion, and the good effect of such prevention, I proceed to the consideration of the wedges as applicable to the prevention of the lateral motion and the effects to be expected therefrom. In order to bring into effective operation the insertion of the wedges, it is absolutely necessary that fixed boundaries should be formed. The curb-stones of the foot-pavement will form such boundaries, on each side of the street, and curb-stones or other restraining fabric may be imbedded across the street at distances varying, according to its width, and governed by other circumstances, and forming either a regular or an irregular polygon or quadrangle: these boundaries will form the resisting or restraining power, without which the wedges would be useless and inoperative; but, being formed, the wedges may then be driven in as before directed, and the whole superficies will, as the wedges operate, gradually and progressively become compact and solid; and will, I have no doubt, maintain its surface unimpaired for many years.

The top of the wedges being driven to the exact level of the stones, the whole surface must therefore necessarily be even. This desirable adjunct can by no means be effected by the present plan of paving, because whenever rain washes away or dilutes the earth, in the manner observed upon, interstices are caused into which the feet of horses slip, and the friction of the iron destroys the angles, and shortly rounds the top of the stones, so that a wheel instead of turning over an even surface, with always an equal bearing, and rolling smoothly along with easy draught as on a railway, jolts onwards from the crown of one stone to the crown of another, forming a convexity upon other convex forms, having only a partial bearing upon the very crowns, and not touching the intermediate parts: hence the stunning noise of the streets by the collision against each succeeding stone; hence the tossings and tumblings in carriages; and hence an increased draught and unnecessary wear and tear of horses, carriages, and harness.

The pavement being formed according to this plan will be almost impervious to wet; the stones of course are so; and as wood naturally swells when wet, the whole pavement will become stronger and more compactly united in wet weather than in dry: but there will of course be small crevices and chinks through which the rain (though in a very small degree) will find its way to the planks; but the perforations provided in them, independent of the crevices between, will be fully sufficient to admit of the water passing to the earth, which, from the protection derived from the planks and wedges, will possess in its consequent dry state very great power of absorption, so that the very small quantity of rain which can reach it, and which it will so readily imbibe, cannot be of any injurious consequence. But should it be thought desirable wholly to exclude rain from penetrating the surface, a small quantity of Parker and Wyatt's Cement, or melted pitch, poured sparingly along the line of wedges, would render it impervious. Upon the whole I should assimilate the state of the streets, and compare them, when constructed upon this plan, to a ship's deck, with the planks well caulked, from which water runs with great facility.

Streets and places that are unusually wide, and not subject to be much used, (as Portland Place and many of the Squares,) may be paved upon the new plan in the centre, and converted into roads on Mr. M'Adam's plan upon both sides.

There is much of general direction towards carrying the plan into effect which might be here noticed; but any surveyor can devise the means most effectual to render it of public benefit: minute points I pass over, having given my attention chiefly to the defective principles hitherto prevailing, and to the invention or application of a new principle to improve, and in some measure (if not wholly) supersede, the former: nor is it necessary for me in the course adopted, in order to make the principle known and available to the public, that all the exactness and minutiæ requisite in a specification of an invention to ground a patent, should be observed.

Whatever considerations of a personal nature I have thought prudent to advance, notice of them is confined to the Advertisement, as more respectful to the public, and in myself more becoming, than to introduce them into pages intended solely for the development of a plan founded in utility, and which must prove particularly interesting and eminently beneficial to the public.

THE END.

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